Harmonica v0.6.0: Forward Modeling, Inversion, and Processing Gravity and Magnetic Data

Fatiando a Terra Project , F. D. Esteban[1], L. Li[2], V. C. Oliveira Jr[3], A. Pesce[4], N. Shea[5], S. R. Soler[6], M. Tankersley[7], and L. Uieda[8]

[1]CONICET, Argentina; Instituto de Geociencias Básicas, Aplicadas y Ambientales de Buenos Aires, Universidad de Buenos Aires, Argentina
[2]School of Earth Sciences, The University of Western Australia, Australia
[3]Observatório Nacional, Brazil
[4]CONICET, Argentina; Instituto Geofísico Sismológico Volponi, UNSJ, San Juan, Argentina
[5]MINES ParisTech
[6]Department of Earth, Ocean and Atmospheric Sciences, University of British Columbia
[7]Antarctic Research Centre, Victoria University of Wellington, New Zealand
[8]Department of Earth, Ocean and Ecological Sciences, School of Environmental Sciences,University of Liverpool, UK

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Abstract

This document describes Harmonica v0.6.0, a software package for gravity and magnetic data processing, forward modeling, and inversion. It is part of the Fatiando a Terra project and is available on Zenodo.

1 Introduction

Harmonica is a Python library for processing and modeling gravity and magnetic data. It includes common processing steps, like calculation of Bouguer and terrain corrections, reduction to the pole, upward continuation, equivalent layers, and more. There are forward modeling functions for basic geometric

shapes, like spheres, prisms, polygonal prisms, and tesseroids. The inversion methods are implemented as classes with an interface inspired by scikit-learn (like Verde).

2 Changelog for Version 0.6.0

Deprecations:

- Deprecate `EQLHarmonic` and `EQLHarmonicSpherical` classes (366).
- Deprecate `isostasy_airy` function (379).
- Deprecate the `synthetic` and `dataset` modules (380).

New features:

- Add function to create a tesseroid layer, similar to the one for the prism layer (316).
- Add function to read Oasis Montaj© `.grd` files as `xarray.DataArray` (348).
- Add option to discard thin prisms when forward modelling a prism layer (373).
- Add FFT-based transformations and filters for horizontal derivatives, upward continuation, reduction to the pole of magnetic grids, and low-pass and high-pass Gaussian filters (299).
- Make horizontal derivative functions compute the derivatives using central finite differences (378).

Maintenance:

- Minor optimization in prism forward modelling (349).
- Set lower bounds for supported dependency versions following NEP29 (356).
- Extend support for Python 3.10 (240).
- Bump versions of style checkers like Black and Flake8 (368).
- Replace `setup.py` with PyPA build (363).
- Clean Harmonica API: make the `forward`, `equivalent_sources`, `gravity_corrections`, `isostasy` and `transformations` submodules private (362).

Documentation:

- Replace Cartopy with PyGMT throughout the documentation (327).

- Fix typo in equivalent sources tutorial (351).
- Add `tesseroid_layer` to the API reference (354).
- Update `README` to match Verde and Boule (358).
- Fix contact link in the documentation sidebar (357).
- Set v0.4.0 as the last with support for Python 3.6 (359).
- Add more papers to "Citing the methods" section in the docs (375).
- Add examples and a user guide page for grid transformations (377).
- Add examples on how to use horizontal derivative functions to the user guide (384).

3 Citation

Please cite this software as:

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Harmonica offers implementations of some methods that have been published in scientific journals. We appreciate citations of these publications as well in case you made use of them.

- `harmonica.EquivalentSources` with `block_size` set (block-averaged sources):
  Soler, S. R. and Uieda, L. (2021). *Gradient-boosted equivalent sources*, Geophysical Journal International. `doi:10.1093/gji/ggab297`
- `harmonica.EquivalentSourcesGB` (Gradient-boosted equivalent sources):
  Soler, S. R. and Uieda, L. (2021). *Gradient-boosted equivalent sources*, Geophysical Journal International. `doi:10.1093/gji/ggab297`
- `harmonica.tesseroid_gravity` (forward modelling of tesseroids with constant and variable density):
  Soler, S. R., Pesce, A., Gimenez, M. E., & Uieda, L. (2019). *Gravitational field calculation in spherical coordinates using variable densities in depth*, Geophysical Journal International. `doi:10.1093/gji/ggz277`